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ON PHORONIS PACIFICA, SP. NOV.

HARRY BEAL TORREY.

DURING the past summer eight specimens of *Phoronis* came into my hands. Five were collected in June, 1894, in Humboldt Bay, California, by an expedition from the University of California. Three were brought back from Puget Sound by the Columbia University expedition of 1897. As the occurrence of *Phoronis* on the Pacific coast has never been recorded, and it is eminently desirable that all localities in which this interesting form may be obtained should be made known to naturalists, I have undertaken to describe this material, which represents a single species hitherto unknown.

The following table will indicate the distribution and date of first description of all the known species of *Phoronis*. For the species presently to be described I propose the name *P. pacifica*.

<i>P. hippocrepia</i> Str. Wright. ¹	1856 Great Britain.
<i>P. ovalis</i> " "	1856.
<i>P. (Crepina) gracilis</i> Van Ben. ²	1858.
<i>P. Buskii</i> McIntosh. ³	1881 Philippines.
<i>P. australis</i> Haswell. ⁴	1882 Port Jackson, N.S.W.
<i>P. Kowalevskii</i> (Caldwell) ⁵ Benham. ⁶	1883 Naples.
<i>P. psammophila</i> Cori. ⁷	1889 Messina. Port Jackson?
<i>P. Sabatieri</i> Roule. ⁸	1889 Gulf of Lyons.
<i>P. architecta</i> Andrews. ⁹	1890 North Carolina.
<i>P. iijimai</i> Oka. ¹⁰	1897 Japan.
<i>P. pacifica</i> .	1901 Humboldt Bay, California; Puget Sound, Washington.

¹ *Proc. Roy. Phys. Soc. Edin.*, vol. i (1856), p. 165; *Edin. New Phil. Journ.*, vol. iv (1856), p. 313. ² *Ann. Sci. Nat.*, 4th ser., vol. x (1858), pp. 11-23.

³ *Proc. Roy. Soc. Edin.*, vol. xi (1881), p. 211; *Chall. Rep. Zool.*, vol. xxvii (1888), 27 pp. ⁴ *Proc. Linn. Soc. N.S.W.*, vol. vii (1882), pp. 606, 607.

⁵ *Proc. Roy. Soc. Lond.*, vol. xxxiv (1883), pp. 371-383.

⁶ *Quart. Journ. Micr. Sci.*, vol. xxx (July, 1889), pp. 125-158.

⁷ *Dissert. Prag* (Juli, 1889); *Zeitschr. f. wiss. Zool.*, vol. li (1890), pp. 480-568.

⁸ *Compt. Rend. Acad. Sci. Paris*, vol. cix (1889), pp. 195, 196.

⁹ *Ann. Mag. Nat. Hist.*, 6th ser., vol. v (1890), pp. 445-449.

¹⁰ *Annot. Zool. Japon.*, vol. i (1897), pp. 147, 148.

Cori has discussed in an interesting fashion all save the last four species. Roule's *P. Sabatieri* and Andrews' *P. architecta* were apparently unknown to him, though descriptions of both were published before the date of his manuscript. *P. Sabatieri* is known to me only through a meager description. It differs from the other European forms in size and habit, and approaches *P. architecta* in these respects. The latter possesses the simple lophophore and comparatively small number of tentacles (60) of the European species. It may be distinguished from them (with the exception of *P. Sabatieri*, with which it may prove identical) by its larger size, its straight tubes and solitary habit, its strong longitudinal muscles (excepting *P. psammophila*), the presence of a ciliated groove in the digestive tract, and possibly by a separation of the sexes. While it agrees fairly well with *P. Buskii* in size, it differs from that species in the other characters enumerated, as well as in the complexity of the lophophore and the number of tentacles. It is thus more closely allied to the European than to the Australian and Philippine forms.

The differences between *P. australis* and *P. Buskii* are merely of habit and size, which has caused Benham to suggest their identity on the supposition that these differences are due to dissimilar environmental conditions.

The description of the Japanese species has been inaccessible, so that I can state nothing with regard to it save its existence.

It is an interesting fact that no one has cared to segregate the species of *Phoronis* under more than one generic name, and indicates the trifling character of the differences which serve to distinguish them. We may separate them, however, into two groups widely separated geographically. In the one belong the European forms, including, perhaps, the American *P. architecta*. In the other belong *P. australis* and *P. Buskii*. We may disregard the Japanese species on account of dearth of information, and the *P. psammophila* which Haswell has found at Port Jackson and which may have been brought from the Mediterranean on a ship's bottom.

P. pacifica occupies a place intermediate between these two groups both geographically and anatomically, but is somewhat

more closely related to the American than to the Australian species. In size it resembles *P. Buskii*, as well as in the complexity of the lophophore; though instead of three coils in the

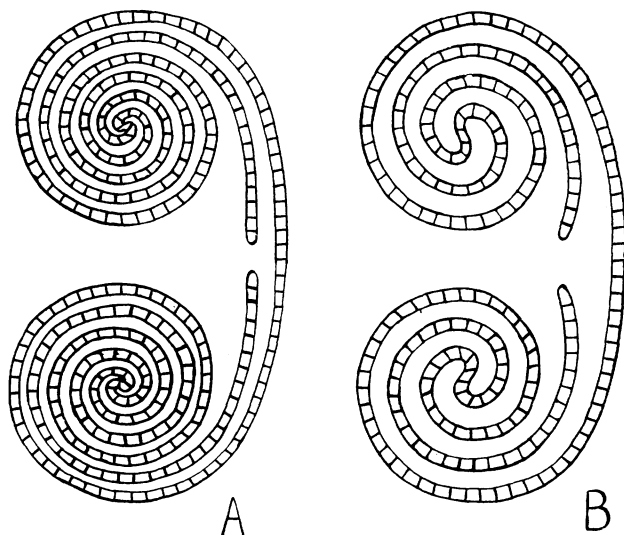


FIG. 1. — Diagrammatic cross-sections of the lophophores of *P. australis* or *P. Buskii* (A), *P. pacifica* (B).

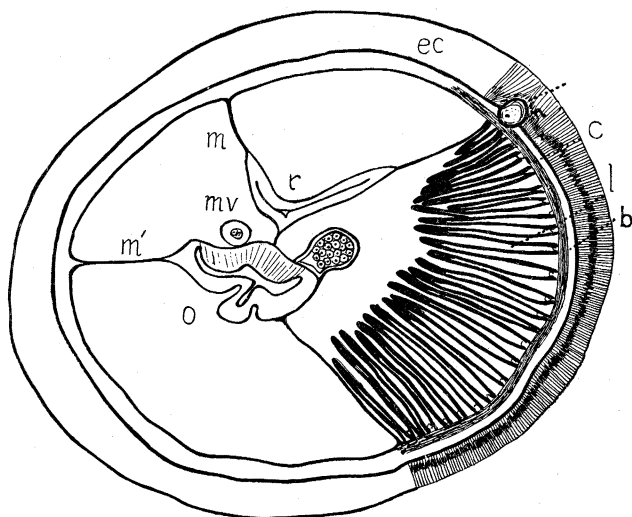


FIG. 2. — Section through the upper third of *P. pacifica*; but one quadrant detailed; semi-diagrammatic. *b*, basement membrane; *c*, circular muscle; *ec*, ectoderm; *l*, longitudinal muscles; *m*, *m'*, mesenteries; *mv*, median vessel; *n*, nerve; *o*, oesophagus; *r*, rectum.

spirals of the lophophore there are one and one-half to two, and a correspondingly smaller number of tentacles (170-200),

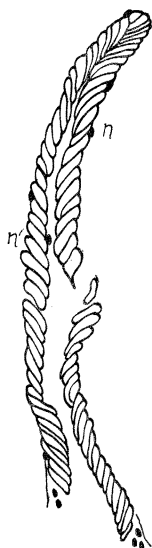


FIG. 3. — Cross-section of one longitudinal muscle ridge of *P. pacifica*, slightly broken.

Fig. 1, *A*, *B*. In the strength of its longitudinal muscles (Figs. 2, 3) it departs from *P. Buskii* and even surpasses *P. architecta*, resembling the latter species in the possession of a specialized ridge in the digestive tract (though this does not pass into the groove that Andrews describes), in the structure of the nervous system, lophophore organ and tube, in habit, and in the possible separation of the sexes.

It is not my intention to enter into a full and detailed anatomical description of *Phoronis*, which the labors of Benham and Cori have rendered largely unnecessary. But a few words on some points may not be out of place.

In one of the Puget Sound specimens spermatogonia and spermatocytes were found packed around the blood vessels in the aboral regions of the body, but no spermatozoa nor ova. The aboral ends of all the Humboldt specimens were wanting, so it was impossible to determine whether they were monoecious or dioecious. In one nephridium three ova were found unaccompanied by spermatozoa; the first polar body was forming in one. As there was no sign of spermatozoa in these eggs, it is probable that in this species fertilization takes place either externally or within the nephridium. It is quite possible that the sexes may be separate, or ova and sperm may be produced by the same individual but not simultaneously.

The blood corpuscles have a conspicuous yellow color and measure 10-15 μ in diameter.

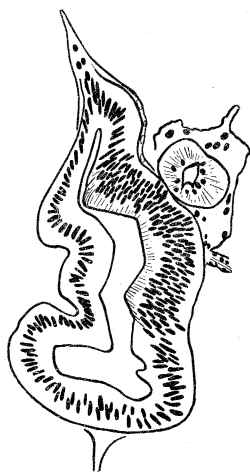


FIG. 4. — Cross-section of the oesophagus of *P. pacifica*, showing the ridge, its base in contact with the median longitudinal blood vessel.

The ciliated ridge was present for a considerable distance in the oesophagus, but could not be seen in the stomach either as a ridge or a groove. In Figs. 2, 4 it is indicated in section, where it appears to be a shallow groove, an appearance probably due to the folding of the wall of the oesophagus. Its position relative to the longitudinal blood vessels is identical with that described for *P. architecta*. The nuclei stain more intensely with haematoxylin than the other nuclei of the oesophagus, and are crowded together usually in several layers. These facts make the area quite conspicuous in section.

The muscles reach their greatest development in the oral third of the body, where they form more than eighty high narrow ridges. In the aboral third these are reduced to a very inconspicuous layer, though still retaining their identity, being separated throughout their length by characteristic folds of peritoneal epithelium.

There is a delicate peritoneum covering the muscle ridges, the nuclei only (Fig. 3, *n*) being seen with ordinary powers of magnification. Occasionally a similar nucleus is found within the fold of muscle (*n'*).

The nervous system is constructed as in *P. architecta*, with one interesting exception. The two longitudinal cords, which are of exceedingly unequal length, instead of ending in the nerve ring of the lophophore, are continuous across the median line at the level of the median mass of ganglion cells. The loop thus formed is closely applied posteriorly to the latter and touches the lophophore nerve on each side of the rectum, apparently without fusing at either point. Just how intimate this contact is cannot be determined from my poorly fixed material. The brevity of the descriptions of this portion of the nervous system in *P. architecta* and other species leads me to suspect that the seemingly exceptional condition in *P. pacifica* may prove to be of more general occurrence.

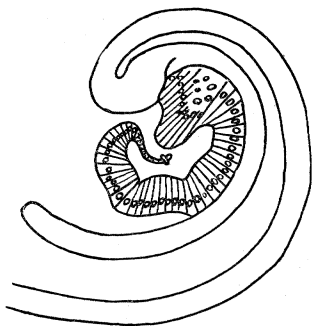


FIG. 5.—Semi-diagrammatic cross-section of lophophore organ within the concavity of the lophophore.

The lophophore organ is extremely variable and may be present or absent, as in *P. psammophila*. It may resemble that of *P. australis*, though differing somewhat in shape (Fig. 5). In this case it is simple, with a thickened glandular epithelium lying for the most part against the inner circle of tentacles, and an outer free non-glandular edge of much lower cells. In another case, however, it had the form of the same organ in *P. architecta* and *P. psammophila*, as described and figured by Andrews and Cori, being composed of a basal lobe and a distal "carpel-like organ." This condition seems to have been attained by the addition of the "carpel-like organ" to the structure (basal lobe) which corresponds to the entire organ in *P. australis*.

The following is a diagnosis of the species, from material preserved in alcohol and formalin :

Total length may be 9 cm., of which the tentacles represent from $2\frac{1}{2}$ to 4 mm.

Diameter, $1\frac{1}{2}$ to 2 mm.

Lophophore spirally coiled, each spiral possessing from $1\frac{1}{2}$ to 2 complete turns.

Tentacles 170 to 200.

Lophophore organ present or absent ; extremely variable in form.

Each animal occurs singly and completely fills tube.

Tube straight, cylindrical, composed of delicate chitin, encrusted with fine sand grains.

Ridge of thickened epithelium in the descending limb of the digestive canal, just beneath the median longitudinal blood vessel.

Longitudinal nerve trunks unite across median line between mouth and anus.

Longitudinal muscles in numerous very high and narrow folds which reach their maximum in the distal third of the body.

Sexes possibly separate.

Localities: Puget Sound, Washington ; Humboldt Bay, California, on sand and mud flats that may be uncovered by the tide.

COLUMBIA UNIVERSITY, January, 1901.